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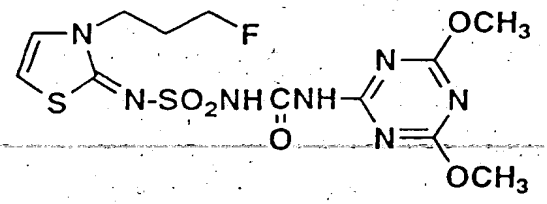
(54) HERBICIDE COMPOSITION

(57) A mixture of a compound represented by the formula (1) and at least one compound selected from the group consisting of phenmedipham, ethofumesate, chloridazon, metamitron and triflusulfuron-methyl, which is safe for sugar beet and has excellent properties.



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Description

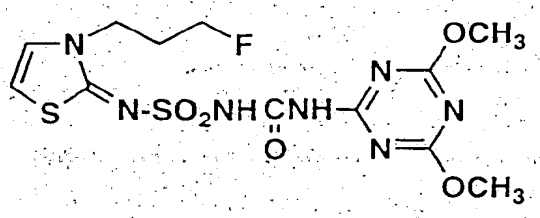
TECHNICAL FIELD

The present invention relates to a herbicidal composition containing a fluoropropylthiazoline derivative and a certain type of herbicide as active ingredients.

BACKGROUND ART

Many years of research and development of herbicides brought a great variety of chemicals into practical use, and these herbicides have contributed to labor saving in weed control and the improvement in the productivity of farm and garden crops. Even in these days, development of new chemicals having more excellent herbicidal properties is still demanded. As agricultural and horticultural herbicides, chemicals which selectively control the target weeds at low doses without showing phytotoxicity to crop plants are particularly desired. However, no existing chemicals satisfy all these desired conditions.

The compound represented by the following formula (1) in the present invention [hereinafter referred to as compound (1)], which was disclosed in International Patent Application PCT/JP95/00011, is a herbicide which shows an excellent herbicidal effect on Graminaceous weeds such as wild oat and blackgrass and broad-leaved weeds such as common lambsquater, common chickweed, kedlock and slender amaranth at low doses in foliage treatment and is fairly safe for sugar beet, but does not have much effect on some broad-leaved weeds.



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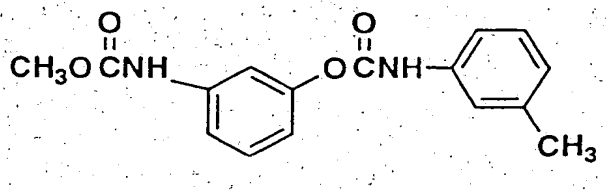
On the other hand, the compound represented by the following formula (2) [hereinafter referred to as compound (2)], the compound represented by the formula (3) [hereinafter referred to as compound (3)], the compound represented by the formula (4) [hereinafter referred to as compound (4)], the compound represented by the formula (5) [hereinafter referred to as compound (5)] and the compound represented by the formula (6) [hereinafter referred to as compound (6)] are already known and in practical use as herbicides for sugar beet, but have a drawback that they don't have much effect on Graminaceous weeds or some broad-leaved weeds.



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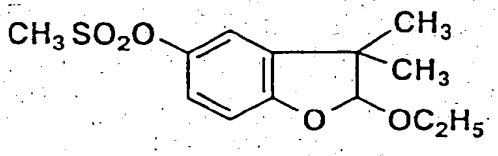

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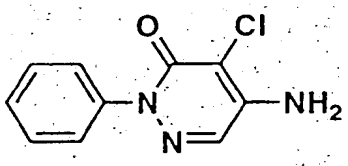

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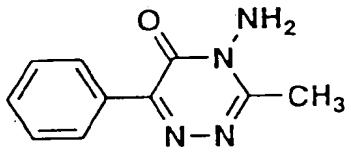

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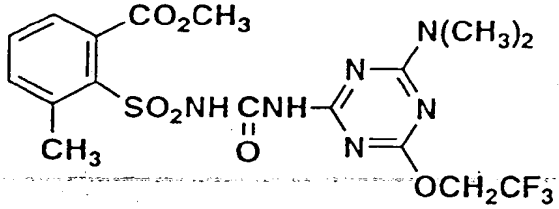

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DISCLOSURE OF THE INVENTION

The present inventors found combined use of compound (1) and at least one compound selected from the group consisting of compound (2), compound (3), compound (4), compound (5) and compound (6) not only compensates for the drawbacks of the individual compounds used in single formulation but also enables reduction in the application dose and simultaneous control of Graminaceous weeds and broad-leaved weeds. The present invention has been accomplished on the basis of this discovery.

The common name of compound (2) in the present invention is phenmedipham, the common name of compound (3) is ethofumesate, the common name of compound (4) is chloridazon, the common name of compound (5) is metamitron, and the common name of compound (6) is triflusulfuron-methyl (test name DPX-66037).

In addition to compound (2), compound (3), compound (4), compound (5) and compound (6), the following compounds may be mentioned as a herbicide which can be used in combination with compound (1). Examples of such formulations will be given later in Formulation Examples 26 to 39.

It is also possible to add one or two of the following compounds to a mixture of compound (1) and at least one compound selected from the group consisting of compound (2), compound (3), compound (4), compound (5) and compound (6).

Desmedipham (common name), cycloate (common name), diallate (common name), lenacil (common name), TCA, pebulate (common name), endothal (common name), EPTC, fluazifop-P-butyl (common name), sethoxydim (common name), haloxyfop-methyl (common name), quizalofop-ethyl (common name), trifluralin (common name), diethatyl-ethyl (common name) and the like may be mentioned. Examples of such formulations will be given later in Formation Examples 40 to 56.

Addition of such a chemical to compound (1) or to a mixture of compound (1) and one of compounds (2) to (6) is expected to lead to, for instance, a broad weeding spectrum, a reduced application dose and persistent herbicidal effect.

In the present invention, compound (1) and one of compounds (2) to (6) are used in an appropriate ratio selected from such a range that the two chemicals do not impair each other's performance.

For example, one of compounds (2) to (6) is used preferably in an amount of from 0.01 to 500 parts by weight, more preferably from 0.1 to 100 parts by weight per 1 part by weight of compound (1).

When the herbicidal composition of the present invention is used as a herbicide, it is usually mixed with a suitable carrier, for instance, a solid carrier such as clay, talc, bentonite, diatomaceous earth or white carbon, or a liquid carrier such as water, an alcohol (such as isopropanol, butanol, benzyl alcohol or furfuryl alcohol), an aromatic hydrocarbon (such as toluene or xylene), an ether (such as an anisole), a ketone (such as cyclohexanone or isophorone), an ester (such as butyl acetate), an acid amide (such as N-methylpyrrolidone) or a halogenated hydrocarbon (such as chlorobenzene). If desired, a surfactant, an emulsifier, a dispersing agent, a penetrating agent, a spreader, a thickener, an antifreezing agent, an anticaking agent or a stabilizer may be added to prepare an optional formulation such as a liquid formulation, an emulsifiable concentrate, a wettable powder, a dry flowable, a flowable, a dust or a granule.

The herbicidal composition of the present invention is fairly safe for sugar beet and effectively controls Graminaceous weeds and broad-leaved weeds, which are harmful to cultivation of sugar beet.

Now, examples of formulations of the herbicidal composition of the present invention will be given below. However, it should be understood that the present invention is by no means restricted to such specific examples.

In the following, "parts" means "parts by weight".

[Formulation Example 1] Wettable powder

Compound (1)	3.5 parts
Compound (2)	28 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries, Co., Ltd.)	61.5 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	2 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 2] Wettable powder

Compound (1)	1 part
Compound (3)	30 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries, Co., Ltd.)	62 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	2 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 3] Wettable powder

Compound (1)	0.5 part
Compound (4)	30 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries, Co., Ltd.)	62.5 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	2 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 4] Wettable powder

Compound (1)	0.5 part
Compound (5)	30 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries, Co., Ltd.)	62.5 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	2 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 5] Wettable powder

Compound (1)	15 parts
Compound (6)	15 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries, Co., Ltd.)	63 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	2 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formation Example 6] Emulsifiable concentrate

Compound (1)	0.5 part
compound (2)	4 parts
Xylene	74.5 parts
Isophorone	15 parts
Sorpol 3005X (Tradename for a mixture of nonionic and anionic surfactants, manufactured by Toho Chemical Industry Co., Ltd.)	6 parts

The above ingredients were homogeneously pulverized and mixed to form an emulsifiable concentrate.

[Formation Example 7] Emulsifiable concentrate

Compound (1)	0.2 part
compound (3)	6 parts
Xylene	72.8 parts
Isophorone	15 parts
Sorpol 3005X (Tradename for a mixture of nonionic and anionic surfactants, manufactured by Toho Chemical Industry Co., Ltd.)	6 parts

The above ingredients were homogeneously pulverized and mixed to form an emulsifiable concentrate.

[Formation Example 8] Emulsifiable concentrate

Compound (1)	0.1 part
compound (4)	6 parts
Xylene	72.9 parts
Isophorone	15 parts
Sorpol 3005X (Tradename for a mixture of nonionic and anionic surfactants, manufactured by Toho Chemical Industry Co., Ltd.)	6 parts

The above ingredients were homogeneously pulverized and mixed to form an emulsifiable concentrate.

[Formation Example 9] Emulsifiable concentrate

Compound (1)	0.1 part
compound (5)	6 parts
Xylene	72.9 parts
Isophorone	15 parts
Sorpol 3005X (Tradename for a mixture of nonionic and anionic surfactants, manufactured by Toho Chemical Industry Co., Ltd.)	6 parts

The above ingredients were homogeneously pulverized and mixed to form an emulsifiable concentrate.

[Formation Example 10] Emulsifiable concentrate

Compound (1)	2.5 parts
compound (6)	2.5 parts
Xylene	74 parts
Isophorone	15 parts
Sorpol 3005X (Tradename for a mixture of nonionic and anionic surfactants, manufactured by Toho Chemical Industry Co., Ltd.)	6 parts

The above ingredients were homogeneously pulverized and mixed to form an emulsifiable concentrate.

[Formulation Example 11] Flowable

Compound (1)	5 parts
Compound (2)	40 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	18.5 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 12] Flowable

Compound (1)	1.5 parts
Compound (3)	45 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	17 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 13] Flowable

Compound (1)	0.75 part
Compound (4)	45 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	17.75 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 14] Flowable

Compound (1)	0.75 part
Compound (5)	45 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	17.75 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 15] Flowable

Compound (1)	20 parts
Compound (6)	20 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	23.5 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 16] Granular wettable powder (dry flowable)

Compound (1)	8 parts
Compound (2)	64 parts
Isoban No. 1 (Tradename for an anionic surfactant, manufactured by Kuraray Isoprene Chemical Co., Ltd.)	10 parts
Vanilex N (Tradename for an anionic surfactant, manufactured by Sanyo-Kokusaku Pulp Co. Ltd.)	5 parts
Carplex #80 (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	13 parts

The above ingredients were homogeneously pulverized and mixed to form a dry flowable.

[Formulation Example 17] Granular wettable powder (dry flowable)

Compound (1)	2.5 parts
Compound (3)	75 parts
Isoban No. 1 (Tradename for an anionic surfactant, manufactured by Kuraray Isoprene Chemical Co., Ltd.)	10 parts
Vanilex N (Tradename for an anionic surfactant, manufactured by Sanyo-Kokusaku Pulp Co. Ltd.)	5 parts
Carplex #80 (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	7.5 parts

The above ingredients were homogeneously pulverized and mixed to form a dry flowable.

[Formulation Example 18] Granular wettable powder (dry flowable)

Compound (1)	1.2 parts
Compound (4)	72 parts
Isoban No. 1 (Tradename for an anionic surfactant, manufactured by Kuraray Isoprene Chemical Co., Ltd.)	10 parts
Vanilex N (Tradename for an anionic surfactant, manufactured by Sanyo-Kokusaku Pulp Co. Ltd.)	5 parts
Carplex #80 (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	11.8 parts

The above ingredients were homogeneously pulverized and mixed to form a dry flowable.

[Formulation Example 19] Granular wettable powder (dry flowable)

Compound (1)	1.2 parts
Compound (5)	72 parts
Isoban No. 1 (Tradename for an anionic surfactant, manufactured by Kuraray Isoprene Chemical Co., Ltd.)	10 parts
Vanilex N (Tradename for an anionic surfactant, manufactured by Sanyo-Kokusaku Pulp Co. Ltd.)	5 parts
Carplex #80 (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	11.8 parts

The above ingredients were homogeneously pulverized and mixed to form a dry flowable.

[Formulation Example 20] Granular wettable powder (dry flowable)

Compound (1)	38 parts
Compound (6)	38 parts
Isoban No. 1 (Tradename for an anionic surfactant, manufactured by Kuraray Isoprene Chemical Co., Ltd.)	10 parts
Vanilex N (Tradename for an anionic surfactant, manufactured by Sanyo-Kokusaku Pulp Co. Ltd.)	5 parts
Carplex #80 (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	9 parts

The above ingredients were homogeneously pulverized and mixed to form a dry flowable.

[Formulation Example 21] Granule

Compound (1)	0.05 part
Compound (2)	0.4 part
Bentonite	50.0 parts
Talc	44.55 parts
Toxanone GR-31A (Tradename for an anionic surfactant, manufactured by Sanyo Chemical Industries, Ltd.)	5 parts

The above ingredients were homogeneously mixed and pulverized, and after addition of a small amount of water, the mixture was kneaded, mixed and granulated by an extrusion-type granulating machine, followed by drying to obtain a granule.

[Formulation Example 22] Granule

Compound (1)	0.015 part
Compound (3)	0.45 part
Bentonite	50.0 parts
Talc	44.535 parts
Toxanone GR-31A (Tradename for an anionic surfactant, manufactured by Sanyo Chemical Industries, Ltd.)	5 parts

The above ingredients were homogeneously mixed and pulverized, and after addition of a small amount of water, the mixture was kneaded, mixed and granulated by an extrusion-type granulating machine, followed by drying to obtain a granule.

[Formulation Example 23] Granule

Compound (1)	0.01 part
Compound (4)	0.6 part
Bentonite	50.0 parts
Talc	44.39 parts
Toxanone GR-31A (Tradename for an anionic surfactant, manufactured by Sanyo Chemical Industries, Ltd.)	5 parts

The above ingredients were homogeneously mixed and pulverized, and after addition of a small amount of water, the mixture was kneaded, mixed and granulated by an extrusion-type granulating machine, followed by drying to obtain a granule.

[Formulation Example 24] Granule

Compound (1)	0.01 part
Compound (5)	0.6 part
Bentonite	50.0 parts
Talc	44.39 parts
Toxanone GR-31A (Tradename for an anionic surfactant, manufactured by Sanyo Chemical Industries, Ltd.)	5 parts

The above ingredients were homogeneously mixed and pulverized, and after addition of a small amount of water, the mixture was kneaded, mixed and granulated by an extrusion-type granulating machine, followed by drying to obtain a granule.

[Formulation Example 25] Granule

Compound (1)	0.25 part
Compound (6)	0.25 part
Bentonite	50.0 parts
Talc	44.5 parts
Toxanone GR-31A (Tradename for an anionic surfactant, manufactured by Sanyo Chemical Industries, Ltd.)	5 parts

The above ingredients were homogeneously mixed and pulverized, and after addition of a small amount of water, the mixture was kneaded, mixed and granulated by an extrusion-type granulating machine, followed by drying to obtain a granule.

[Formulation Example 26] Flowable

Compound (1)	4 parts
Desmedipham	40 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	19.5 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 27] Wettable powder

Compound (1)	0.5 part
Cycloate	30 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries Co., Ltd.)	44.5 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	20 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 28] Wettable powder

Compound (1)	1 part
Diallate	30 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries Co., Ltd.)	44 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	20 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 29] Flowable

Compound (1)	2.5 parts
Lenacil	40 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	21 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 30] Flowable

Compound (1)	0.4 part
TCA	40 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	23.1 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 31] Wettable powder

Compound (1)	0.75 part
Pebulate	30 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries Co., Ltd.)	44.25 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	20 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 32] Flowable

Compound (1)	2 parts
Endothal	40 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	21.5 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 33] Wettable powder

Compound (1)	0.75 part
EPTC	30 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries Co., Ltd.)	44.25 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	20 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 34] Wettable powder

Compound (1)	8 parts
Fluazifop-P-butyl	20 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries Co., Ltd.)	47 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	20 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 35] Wettable powder

Compound (1)	4 parts
Sethoxydim	32 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries Co., Ltd.)	39 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	20 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 36] Flowable

Compound (1)	7 parts
Haloxyfop-methyl	39.2 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	17.3 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 37] Flowable

Compound (1)	20 parts
Quizalofop-ethyl	20 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	23.5 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 38] Flowable

Compound (1)	4 parts
Trifluralin	40 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	19.5 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 39] Flowable

Compound (1)	2 parts
Diethatyl-ethyl	40 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	21.5 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 40] Wettable powder

Compound (1)	0.75 part
Compound (2)	6 parts
Diallate	22.5 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries Co., Ltd.)	45.75 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	20 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 41] Wettable powder

Compound (1)	2.6 parts
Compound (2)	20.8 parts
Fluazifop-P-butyl	6.5 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries Co., Ltd.)	45.1 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	20 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 42] Wettable powder

Compound (1)	1.8 parts
Compound (2)	14.4 parts
Sethoxydim	14.4 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries Co., Ltd.)	44.4 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	20 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 43] Flowable

Compound (1)	2.8 parts
Compound (2)	22.4 parts
Haloxyfop-methyl	15.68 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	22.62 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 44] Flowable

Compound (1)	4 parts
Compound (2)	32 parts
Quizalofop-ethyl	4 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	23.5 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 45] Flowable

Compound (1)	2 parts
Compound (2)	16 parts
Trifluralin	20 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	25.5 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 46] Flowable

Compound (1)	1.4 parts
Compound (2)	11.2 parts
Diethatyl-ethyl	28 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	22.9 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 47] Wettable powder

Compound (1)	0.8 part
Compound (3)	24 parts
Sethoxydim	6.4 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries Co., Ltd.)	43.8 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	20 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 48] Flowable

Compound (1)	1.25 parts
Compound (3)	37.5 parts
Quizalofop-ethyl	1.25 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	23.5 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 49] Wettable powder

Compound (1)	0.5 part
Compound (4)	30 parts
Sethoxydim	4 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries Co., Ltd.)	40.5 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	20 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 50] Flowable

Compound (1)	0.65 part
Compound (4)	39 parts
Quizalofop-ethyl	0.65 part
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	23.2 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 51] Wettable powder

Compound (1)	0.5 part
Compound (5)	30 parts
Sethoxydim	4 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries Co., Ltd.)	40.5 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	20 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 52] Flowable

Compound (1)	0.65 part
Compound (5)	39 parts
Quizalofop-ethyl	0.65 part
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	23.2 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 53] Wettable powder

Compound (1)	7 parts
Compound (6)	7 parts
Fluazifop-P-butyl	17.5 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries Co., Ltd.)	43.5 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	20 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 54] Wettable powder

Compound (1)	3 parts
Compound (6)	3 parts
Sethoxydim	24 parts
Zeeklite PFP (Tradename for a kaolin-type clay, manufactured by Zeeklite Industries Co., Ltd.)	45 parts
Sorpol 5050 (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	2 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	3 parts
Carplex #80 (anticaking agent) (Tradename for a white carbon, manufactured by Shionogi Pharmaceutical Co., Ltd.)	20 parts

The above ingredients were homogeneously pulverized and mixed to form a wettable powder.

[Formulation Example 55] Flowable

Compound (1)	6 parts
Compound (6)	6 parts
Haloxyfop-methyl	33.6 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	17.9 parts

The above ingredients were homogeneously mixed to form a flowable.

[Formulation Example 56] Flowable

Compound (1)	15 parts
Compound (6)	15 parts
Quizalofop-ethyl	15 parts
Agrizole S-711 (Tradename for a nonionic surfactant, manufactured by Kao Corporation)	8 parts
Lunox 1000C (Tradename for an anionic surfactant, manufactured by Toho Chemical Industry Co., Ltd.)	0.5 part
1% Rodopol water (Tradename for a thickener, manufactured by Rhône-Poulenc)	20 parts
Ethylene glycol (anti-freezing agent)	8 parts
Water	18.5 parts

The above ingredients were homogeneously mixed to form a flowable.

Now, the following Text Examples are given to demonstrate that the combination of compound (1) with one of compounds (2) to (6) has a more excellent effect than their single formulations anticipate, namely has a synergic effect.

TEST EXAMPLE 1

Plastic box having a length of 33 cm, a width of 33 cm and a depth of 8 cm were filled with sterilized diluvial soil, and slender amaranth was sown at a depth of about 1.5 cm dep in each box. The plant was grown in a greenhouse at a temperature of from 20 to 25°C for 14 days and then treated with chemicals. Wettable powders of compound (1), compound (2), compound (3) and their mixtures were suspended and diluted with water to predetermined concentrations, and 10 ml of each suspension was uniformly applied to the foliage. The plant was grown in the plastic boxes placed in a greenhouse. 28 Days after the treatment, the aerial parts of slender amaranth were weighed, and the control rates (Eo) were calculated from the following formula.

$$Eo(\%) = [1-(\text{the weight of the plant in a treated area}/\text{the weight of the plant in the non-treated area})] \times 100$$

Although individual active compounds usually have drawbacks in their herbicidal activities, the herbicidal effect of a mixture of two active compounds can exceed the simple sum of the effects of the individual compounds (the expected control rate). In such a case, it is called synergy. The expected control rate Ec of a specific combination of two herbicides is calculated as follows (Colby S.R., calculation of synergic and antagonistic effects of herbicide combinations, "Weed", vol. 15, pp. 20-22, 1967).

$$Ec = \alpha+\beta-(\alpha \cdot \beta)/100$$

α: The control rate of herbicide A applied at a rate of (a) kg/ha.
β: The control rate of herbicide B applied at a rate of (b) kg/ha.
Ec: The expected control rate of herbicide A applied at a rate of (a) kg/ha and herbicide B applied at a rate of (b) kg/ha.

Namely, when Eo is larger than Ec, the effect of the herbicide combination is considered as synergy.
The results are shown in Table 1 and Table 2. The symbol in the Tables has the following meaning.

A: Slender amaranth

Table 1

Herbicidal effects of single formulations (control rate %)		
Compound	Application rate of active ingredient (g/a)	A
Compound (1)	0.1	71
	0.2	81
	0.4	85
Compound (2)	1.6	0
	3.2	0
	6.4	5
Compound (3)	1.6	0
	3.2	9
	6.4	38

Table 2

Actual and expected herbicidal effects of mixtures (control rate %)		
Application rate of active ingredient (g/a)	A	
	Actual value	Expected value
Comp.(1) + Comp.(2)		
0.1 + 1.6	85	71
0.1 + 3.2	85	71
0.1 + 6.4	85	72
0.2 + 1.6	90	81
0.2 + 3.2	90	81
0.2 + 6.4	92	82
0.4 + 1.6	95	85
0.4 + 3.2	98	85
0.4 + 6.4	100	86
Comp.(1) + Comp.(3)		
0.1 + 1.6	84	71
0.1 + 3.2	86	74
0.1 + 6.4	89	82
0.2 + 1.6	90	81
0.2 + 3.2	90	83
0.2 + 6.4	93	88
0.4 + 1.6	95	85
0.4 + 3.2	95	86
0.4 + 6.4	98	91
(The expected values in the table are calculated from Colby's equation, which is mentioned above.)		

From the results in Table 2, it is evident that mixtures of compound (1) with compound (2) and compound (3) have effects exceeding the expected values and act synergically on slender amaranth.

TEST EXAMPLE 2

Plastic boxes having a length of 33 cm, a width of 33 cm and a depth of 8 cm were filled with sterilized diluvial soil, and tufted knotweed was sown at a depth of about 1.5 cm. The plant was grown in a greenhouse at a temperature of from 20 to 25°C and then treated with chemicals. Wettable powders of compound (1), compound (4), compound (5) and their mixtures were suspended and diluted with water to predetermined concentrations, and then 10 ml of each suspension was uniformly applied to the foliage. The plant was grown the plastic box is placed in a greenhouse. 28 Days after the application, the aerial parts of tufted knotweed were weighed, and the control rates (Eo) were calculated in the same manner as in Test Example 1. The results are shown in Table 3 and Table 4. The symbol in the Tables has the following meaning.

B: Tufted knotweed

Table 3

Herbicidal effects of single formulations (control rate %)		
Compound	Application rate of active ingredient (g/a)	B
Compound (1)	0.1	62
	0.2	71
	0.4	80
Compound (4)	1.6	29
	3.2	66
	6.4	100
Compound (5)	1.6	0
	3.2	30
	6.4	43

Table 4

Actual and expected herbicidal effects of mixtures (control rate %)		
Application rate of active ingredient (g/a)	B	
	Actual value	Expected value
Comp.(1) + Comp.(4)		
0.1 + 1.6	80	73
0.1 + 3.2	93	87
0.1 + 6.4	100	100
0.2 + 1.6	85	79
0.2 + 3.2	95	90
0.2 + 6.4	100	100
0.4 + 1.6	89	86
0.4 + 3.2	100	93
0.4 + 6.4	100	100
Comp.(1) + Comp.(5)		
0.1 + 1.6	73	62
0.1 + 3.2	80	73
0.1 + 6.4	83	78
0.2 + 1.6	83	71
0.2 + 3.2	85	80
0.2 + 6.4	90	83
0.4 + 1.6	83	80
0.4 + 3.2	90	86
0.4 + 6.4	95	89
(The expected values in the table are calculated from Colby's equation, which is mentioned above.)		

The results in Table 4 clearly indicate that mixtures of compound (1) with compound (4) and compound (5) have effects exceeding the expected values and act synergically on tufted knotweed.

TEST EXAMPLE 3 Herbicidal effects and phytotoxicity test

Plastic boxes having a length of 33 cm, a width of 33 cm and a depth of 8 cm were filled with sterilized diluvial soil, and sugar beet, wild oat, blackgrass, common lambsquater, common chickweed, kedlock, tufted knotweed and slender amaranth were sown in each box at a depth of about 1.5 cm. The plants were grown in a greenhouse at a temperature of from 20 to 25°C for 14 days and then the flowables prepared in accordance with Formulation Example 11, Formulation Example 12, Formulation Example 13, Formulation Example 14 and Formulation Example 15 were diluted with water and applied uniformly to the foliage. 28 Days after the application, the effects on respective weeds and sugar beet were evaluated on the basis of the following standard ratings.

Standard ratings

5: Complete destruction or control rat of more than 90%

4: Control rate of from 70 to 90%
3: Control rate of from 40 to 70%
2: Control rate of from 20 to 40%
1: Control rate of from 5 to 20%
0: Control rate of less than 5%

The results are shown in Table 5. The symbols in the Table have the following meanings.

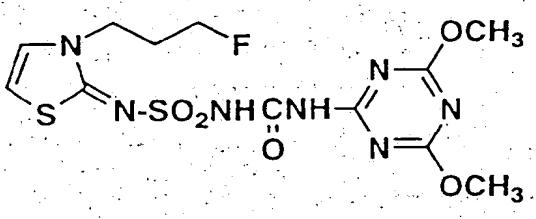
A: sugar beet, B: wild oat, C: blackgrass, D: common lambsquater, E: common chickweed, F: kedlock, G: tufted knotweed, H: slender amaranth

Table 5

Herbicidal effect and phytotoxicity against sugar beet									
	Application rate of flowable (g/a)	A	B	C	D	E	F	G	H
Example 11	10	0	5	5	5	5	5	5	5
Example 12	33	0	5	5	5	5	5	5	5
Example 13	67	0	5	5	5	5	5	5	5
Example 14	67	0	5	5	5	5	5	5	5
Example 15	2.5	0	5	5	5	5	5	5	5

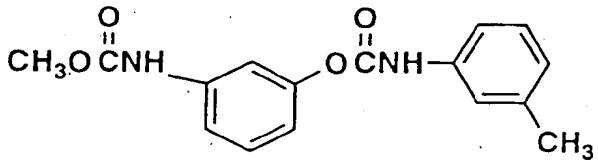
Claims

1. A herbicidal composition containing a fluoropropylthiazoline derivative represented by the formula (1):

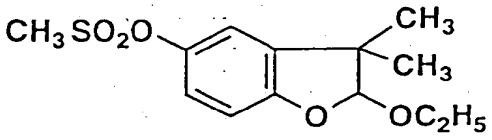


(1)

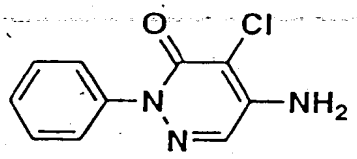
and at least one compound selected from the group consisting of compounds represented by the following formulae (2), (3), (4), (5) and (6) as active ingredients.



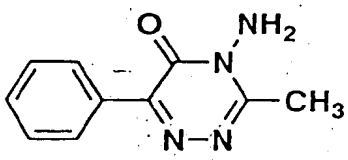
(2)



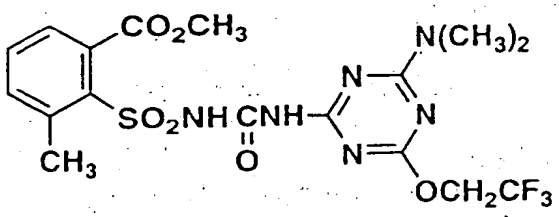
(3)



(4)



(5)



(6)

2. The herbicidal composition according to Claim 1, which contains the compound represented by the formula (2) in combination with the fluoropropylthiazoline derivative.

3. The herbicidal composition according to Claim 1, which contains the compound represented by the formula (3) in combination with the fluoropropylthiazoline derivative.

4. The herbicidal composition according to Claim 1, which contains the compound represented by the formula (4) in combination with the fluoropropylthiazoline derivative.

5. The herbicidal composition according to Claim 1, which contains the compound represented by the formula (5) in combination with the fluoropropylthiazoline derivative.

6. The herbicidal composition according to Claim 1, which contains the compound represented by the formula (6) in combination with the fluoropropylthiazoline derivative.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP95/01251

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl^6 A01N47/36
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
Int. Cl^6 A01N47/36, A01N47/22, A01N43/08, A01N43/58, A01N43/707

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 5-229907, A (DU PONT JAPAN LIMITED), September 7, 1993 (07. 09. 93) & EP, 595842, A1 & CN, 1069392, A & AU, 9222215, A & WO, 9300011, A1	1 - 6
A	JP, 5-262609, A (Nissan Chemical Industries, Ltd.), October 12, 1993 (12. 10. 93) (Family: none)	1 - 6
A	JP, 5-339112, A (Idemitsu Kosan Co., Ltd.), December 21, 1993 (21. 12. 93) & EP, 573897, A1 & AU, 9339970, A & CA, 2097899, A & US, 5344809, A	1 - 6

☑ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
September 6, 1995 (06. 09. 95)	September 26, 1995 (26. 09. 95)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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